



Imaging sedation and anesthesia practice patterns in pediatric radiology departments — a survey of the Society of Chiefs of Radiology at Children’s Hospitals (SCORCH)

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Abstract

Background There are few data describing practice patterns related to the use of sedation/anesthesia for diagnostic imaging in pediatric radiology departments.

Objective To understand current practice patterns related to imaging with sedation/anesthesia in pediatric radiology departments based on a survey of the Society of Chiefs of Radiology at Children’s Hospitals (SCORCH) in conjunction with the American College of Radiology’s Pediatric Imaging Sedation and Anesthesia Committee.

Materials and methods A multi-question survey related to imaging with sedation/anesthesia in pediatric radiology departments was distributed to SCORCH member institutions in January 2019. A single reminder email was sent. Descriptive statistical analyses were performed.

Results Of the 84 pediatric radiology departments, 23 (27%) completed the survey. Fifty-seven percent of the respondents self-identified as academic/university-affiliated and 13% as a division/section in an adult radiology department. Imaging sedation (excluding general anesthesia) is commonly performed by pediatric anesthesiologists (76%) and intensive care unit physicians (intensivists, 48%); only 14% of departments expect their pediatric radiologists to supervise imaging sedation. Ninety-six percent of departments use child life specialists for patient preparation. Seventy percent of departments have preparatory resources available on a website, including simulation videos (26%) and audio clips (17%). Nearly half (48%) of the departments have a mock scanner to aid in patient preparation. Imaging sedation/anesthesia is most often scheduled at the request of ordering clinicians (65%), while 57% of departments allow schedulers to place patients into imaging sedation/anesthesia slots based on specified criteria.

Conclusion Imaging sedation/anesthesia practice patterns vary among pediatric radiology departments, and understanding current approaches can help with standardization and practice improvement.

Keywords Anesthesia · Children · Pediatric radiology · Sedation · Survey

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Introduction

There are few data describing sedation and anesthesia practice patterns in pediatric radiology departments. While radiologists commonly supervised diagnostic imaging-related sedation in the past, non-radiologist providers are now being used to deliver imaging-related sedation and anesthesia [1–3]. The exact methods of sedation and anesthesia used as well as who delivers them in modern-day pediatric imaging departments are mostly unknowns. There also is a paucity of available data regarding patient preparation practices in pediatric radiology, such as the use of certified child life specialists, web-based materials/tools and mock scanners. Furthermore, little is known about the decision-making process regarding the use

of sedation/anesthesia in modern-day pediatric radiology departments.

The purpose of this study was to understand current diagnostic imaging sedation and anesthesia practice patterns in pediatric radiology departments based on a survey of member institutions of the Society of Chiefs of Radiology at Children's Hospitals (SCORCH). The survey was created by the American College of Radiology's (ACR's) Pediatric Imaging Sedation and Anesthesia Committee, which was formed under the direction of the ACR's Pediatric Quality and Safety Committee and Pediatric Commission. The knowledge gained has the potential to help pediatric radiology departments as well as their radiologists evaluate their current practice patterns in comparison to peer institutions and to make meaningful practice quality improvement changes.

Materials and methods

This survey-based study was determined to be institutional review board (IRB)-exempt research (Children's Hospital of Philadelphia, Philadelphia, PA) and thus did not require informed consent. No protected health information was collected.

A survey composed of 27 unique questions related to the use of sedation and anesthesia in pediatric radiology departments was created by the ACR's Pediatric Imaging Sedation and Anesthesia Committee. Questions were related to the methods of sedation/anesthesia used for diagnostic imaging tests, performance/supervision of imaging-related sedation, pre-imaging patient preparation and the use of child life specialists, and scheduling of sedation/anesthesia for diagnostic imaging tests. Ten questions, including sub-questions, are presented in this study ([Appendix](#)). Questions were a combination of select all answers that apply, yes or no, and open-ended responses.

The complete survey was distributed by email to 84 SCORCH member institution radiologists-in-chief, department chairs or division/section directors for completion during January 2019 via SurveyMonkey (San Mateo, CA). A single reminder email was sent after 4 weeks. Only one survey response was allowed per institution.

Survey results were summarized as counts and percentages. (Note: Some questions were answered by fewer than the 23 respondents.) Descriptive statistical analyses were performed using Microsoft Excel Office 365 (Microsoft Corporation, Redmond, CA).

Results

Of the 84 SCORCH member institutions, 23 (27%) completed the survey. While all respondents (chiefs, chairs, division directors or their designees) represent dedicated children's

hospitals or pediatric radiology departments, other characteristics of these various pediatric radiology groups include the following: 13/23 (57%) academic/university-affiliated, 3/23 (13%) pediatric radiology division/section in an adult radiology department and 2/23 (9%) private practice.

Who performs imaging sedation?

Sedation (excluding general anesthesia) for imaging studies is most often performed by pediatric anesthesiologists (16/21, 76%); however, other physician specialties commonly provide sedation services, including intensive care unit physicians (i.e. intensivists; 10/21, 48%), hospitalists (4/21, 19%) and emergency department physicians (4/21, 19%). Sedation is provided only by dedicated pediatric anesthesiologists for imaging studies in 7/21 (33%) departments. Only 3/21 (14%) pediatric radiology departments authorize their radiologists to perform/supervise imaging sedation.

Anesthesiologists use intravenous propofol for imaging sedation in 22/23 (96%) departments, while intensivists (9/23, 39%), certified registered nurse anesthetists (CRNA) (5/23, 22%), hospitalists (3/23, 13%) and emergency department physicians (3/23, 13%) also are allowed to use it at some institutions. Intravenous propofol is not administered by a radiologist in any of the pediatric radiology departments.

Methods for improving patient cooperation and decreasing motion

A variety of techniques are used to improve pediatric patient cooperation and decrease patient motion that may degrade image quality. In 22/23 (96%) pediatric radiology departments, child life specialists participate in imaging encounters, while 21/23 (91%) also use radiology technologists and/or nurses to provide patient distraction techniques.

In 16/23 (70%) departments, preparatory resources are available on a departmental website for patients before their visit; 6/23 (26%) have simulation videos, while 4/23 (17%) have audio clips. Nearly half (11/23, 48%) of the responding departments have some form of simulated or mock scanner to further assist with patient preparation.

A range of sedation techniques also may be used to improve patient cooperation and decrease patient motion, depending on the patient and the needs of the imaging study being performed. Of the departments, 17/23 (74%) offer mild sedation or anxiolysis using oral medications such as midazolam (versed), while in some patients moderate (13/23, 57%; e.g., oral chloral hydrate or intravenous fentanyl and midazolam) or deep (16/23, 70%) sedation may be necessary to achieve diagnostic imaging.

Who schedules sedation for diagnostic imaging?

Imaging with sedation/anesthesia is most often arranged by a scheduler at the request of the ordering clinician (15/23, 65%), while 13/23 (57%) departments allow schedulers to place patients into imaging with sedation/anesthesia slots based on age or other departmental guidelines/criteria. The need for sedation/anesthesia is determined by a nurse or imaging technologist in 8/23 (35%) and 5/23 (22%) departments, respectively. Sixteen (70%) of the 23 departments contact the ordering clinician or patient’s family before the imaging test to determine the appropriate level of sedation/anesthesia indicated, with this task commonly performed by a nurse or nurse practitioner (10/23, 43%).

Expectations for pediatric radiologists

Only 3/23 (13%) departments expect pediatric radiologists to discuss the risks of sedation/anesthesia related to imaging with families, and 6/21 (29%) departments provide information regarding such risks on an institutional website. Only 3/22 (14%) departments require attending radiologists to be American Heart Association Pediatric Advanced Life Support (PALS) certified.

Practice recommendations for sedation/general anesthesia related to pediatric imaging, based on ≥66% of respondents endorsing a particular practice, are provided in Table 1.

Discussion

This study explores modern-day practice patterns related to pediatric diagnostic imaging and the use of sedation/anesthesia. Our results are based on 23 dedicated pediatric radiology departments, more than half of which are academic or university-affiliated. Our study confirms that while pediatric anesthesiologists very commonly administer sedation for pediatric medical imaging, a variety of other specialties also provide it to children undergoing imaging examinations, including intensivists, hospitalists and emergency department physicians [2]. Not surprisingly, our study confirms that pediatric radiologists provide sedation in only a minority of departments as of 2019, likely based on departmental and/or hospital/institutional policy. Our study also shows that a range of sedation is employed for diagnostic imaging studies, ranging from oral anxiolytic medications to deep sedation using intravenous medications, such as propofol.

Our study confirms that child life specialists are nearly ubiquitous in today’s pediatric radiology department. These practitioners, who are educated and clinically trained to assist patient and family medical care, improve satisfaction and experience, help pediatric patients cope with stressful and potentially traumatic medical procedures, and play a critical role in preparing pediatric patients for their upcoming imaging examinations as well as offer distraction techniques to get children through the

Table 1 Practice recommendations related to sedation/general anesthesia and pediatric imaging

Specific recommendation	Number (%) of institutions endorsing practice
Sedation (including general anesthesia) for imaging studies should be performed by dedicated pediatric anesthesiologists, if available	16/21 (76%)
The administration of propofol for imaging studies is preferably administered by dedicated pediatric anesthesiologists, although other providers may be able to competently administer as well (e.g., intensivists, emergency department physicians)	22/23 (96%)
Dedicated child life specialists should be available to pediatric radiology departments, as needed, for a variety of imaging studies and procedures	22/23 (96%)
Dedicated pediatric radiology technologists and/or nurses should be capable of providing patient distraction techniques during imaging studies and procedures	21/23 (91%)
Pediatric radiology groups should make preparatory resources available to patients before their visit, such as on a departmental website	16/23 (70%)
Pediatric radiology departments should offer varying levels of sedation, ranging from mild sedation or anxiolysis using oral medications such as midazolam (versed) ¹ to deep sedation using intravenous medications ² in order to achieve diagnostic imaging	¹ 17/23 (74%) ² 16/23 (70%)
Pediatric radiology departments should contact the ordering clinician or a patient’s family before the imaging test to triage the appropriate level of sedation/anesthesia indicated	16/23 (70%)

These recommendations are based on ≥66% respondents endorsing a particular practice

examination itself, often with no or minimal sedation [4–7]. Similarly, pediatric imaging technologists and nurses, like child life specialists, also spend time reassuring patients and providing needed distractions.

While most pediatric radiology departments have a website for patients and parents, a minority of the websites contain simulation videos or audio clips (e.g., mimicking the noises created by a magnetic resonance imaging [MRI] scanner). There is a small but increasing number of studies demonstrating that such videos and audio clips as well other computer- and phone-based applications improve the pediatric imaging experience (including decreased anxiety) and patient cooperation, and likely decrease the need for sedation [8, 9]. On a positive note, almost half of the responding departments have some form of a mock scanner (e.g., “teddy bear” versus full scale) that can be used to prepare patients for their upcoming imaging study. Such mock scanners have been shown to improve the pediatric patient experience, decrease patient and parent anxiety, improve patient cooperation, decrease MRI motion artifacts and even decrease the use of general anesthesia [10–13].

Determining which pediatric patients require sedation or anesthesia for their diagnostic imaging test can be challenging. Our study indicates there is variability in how patients are scheduled for imaging with sedation/anesthesia. In many departments, patients are, at least initially, scheduled to be imaged with sedation or anesthesia based on the request of the ordering clinician or based on established departmental/institutional guidelines/criteria. Unfortunately, we believe it is likely that referring clinicians are often unaware of what goes into an imaging examination and, as a result, sedation or anesthesia may be requested for some children who do not need it or conversely not requested for some children who could benefit from it. Similarly, departmental/institutional guidelines/criteria may be overly liberal, with more children undergoing imaging with sedation or anesthesia than necessary. Fortunately, many departments, based on our survey, have an individual or individuals who contact ordering clinicians and/or patient families to triage the level of sedation (or anesthesia) anticipated/potentially required for a given child, if needed at all.

The availability of high-quality sedation and anesthesia is critical to the modern-day pediatric radiology department [14]. Without sedation or anesthesia, certain diagnostic imaging tests, such as computed tomography and MRI, may be severely compromised or even nondiagnostic. However, imaging with sedation/anesthesia also has drawbacks. First, sedation/anesthesia requires additional

resources, prolongs imaging encounters and adds cost to the health care system [15]. Second, there is increasing concern that exposure to sedation and anesthesia, especially in the first few years of life, may adversely affect the developing brain [16–19]. Therefore, understanding our current practice patterns and potential ways to further decrease the use of imaging sedation is crucial. Third, sedation and anesthesia can be associated with adverse events, such as oxygen desaturation, apnea, aspiration and cardiopulmonary arrest. However, a very large study from 37 institutions that included 49,836 propofol-based sedation or anesthesia encounters outside of the operating room demonstrated no deaths and only the need for cardiopulmonary resuscitation in only two patients, demonstrating the overall safety of sedation and anesthesia [3]. Fourth, the use of sedation and anesthesia has a substantial impact on workflows, adding scheduling complexity as well as multiday logistical issues (related to patient arrival, preparation before imaging, etc.). Finally, the use of sedation and anesthesia increases the number of individuals and amount of medical equipment in MRI safety zone 4, thereby potentially increasing the risk of an MRI safety adverse event.

Our study has limitations. First, it is based on a survey of predominantly academic pediatric radiology departments in the United States. While our response rate was 27%, we believe that the 23 responding institutions represent a variety of departments with differing characteristics and, thus, our results are likely generalizable to the field. Second, our results are based on current everyday practices, and they are not necessarily evidence-based best practices or supported by rigorous scientific study. Finally, our study specifically deals with pediatric imaging with sedation/anesthesia and is not generalizable to other patient populations (e.g., adults).

Conclusion

Practice patterns related to imaging with sedation/anesthesia vary among pediatric radiology departments. Our study presents up-to-date information showing who is performing sedation for imaging, how children and their families are being prepared for imaging studies, and how imaging with sedation/anesthesia is scheduled. The results of our study can be used to better understand the role of sedation/anesthesia in pediatric imaging, potentially providing opportunities for standardization within and among institutions as well as meaningful practice improvement changes.

Appendix

ACR Pediatric Sedation and Anesthesia Committee Survey

<p>Please describe your practice. Check all that apply</p>	<ul style="list-style-type: none"> -Children’s hospital -Pediatric radiology section in adult radiology department -Private practice -Academic/university affiliated -Nonacademic
<p>Who performs sedation (not GA) at your institution for radiology studies, excluding interventional radiology? Check all that apply</p>	<ul style="list-style-type: none"> -Radiologist -Hospitalist/pediatrician -Intensivist (ICU/NICU/PICU/CICU) -ED physician -Adult anesthesiologist -Pediatric anesthesiologist
<p>Who administers IV propofol for radiology studies? Check all that apply</p>	<ul style="list-style-type: none"> -Radiologist -Hospitalist/pediatrician -Intensivist (ICU/NICU/PICU/CICU) -ED physician -Anesthesiologist -Supervised CRNA
<p>Which methods are used in your department to decrease motion and increase cooperation for imaging studies? Check all that apply</p>	<ul style="list-style-type: none"> -Radiology technologist and/or nurse using distraction techniques -Child life specialist participation -Anxiolysis (oral versed, valium, Ativan) -Moderate sedation (oral medications such as chloral hydrate or pentobarbital or IV versed, fentanyl) -Deep sedation (IV medications other than propofol) -IV propofol only -General anesthesia
<p>Does your department have preparation guidance that patients can access prior to the appointment?</p>	<ul style="list-style-type: none"> -Department website or link (yes/no) -Instructions via department website or link (yes/no) -Simulation video via department website or link (yes/no) -Audio of noise via department website or link (yes/no) -Do you have a mock scanner that can be used to simulate the experience prior to the study? (yes/no)
<p>Who schedules sedation/GA? Check all that apply</p>	<ul style="list-style-type: none"> -Receptionist/scheduler -Schedule with sedation/GA order from requesting clinician -Receptionist/scheduler -Schedule in sedation/GA slot using age or other guidelines -Nursing staff -Radiology technologists Other staff – (please specify)
<p>If sedation/GA is ordered, does someone from the radiology department reach out to the physician or parent to determine the level of sedation needed?</p>	<ul style="list-style-type: none"> -Yes -No If yes, please provide role of person who provides contact
<p>Are the radiologists in your department expected to be able to discuss with parents the risks of sedation and anesthesia?</p>	<ul style="list-style-type: none"> -Yes -No
<p>Does your institution or department provide information regarding the risks of sedation/anesthesia on a hospital (departmental) website?</p>	<ul style="list-style-type: none"> -Yes -No
<p>Are the radiologists in your group required to be PALS certified?</p>	<ul style="list-style-type: none"> -Yes -No

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Compliance with ethical standards

Conflicts of interest None

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